(12) UK Patent Application (19) GB (11) 2 361 970 (13) A

(43) Date of A Publication 07.11.2001

(21) Application No 0010805.0

(22) Date of Filing 05.05.2000

(71) Applicant(s)
Delphi Technologies Inc
(Incorporated in USA - Delaware)
5725 Delphi Drive, Troy, Michigan 48098-2815,
United States of America

(72) Inventor(s)
James Anthony Larkin

(74) Agent and/or Address for Service
Urquhart-Dykes & Lord
New Priestgate House, 57 Priestgate,
PETERBOROUGH, PE1 1JX, United Kingdom

(51) INT CL[7]
F16D 65/097

(52) UK CL (Edition S)
F2E EEL E2N1C1 E2N1C3

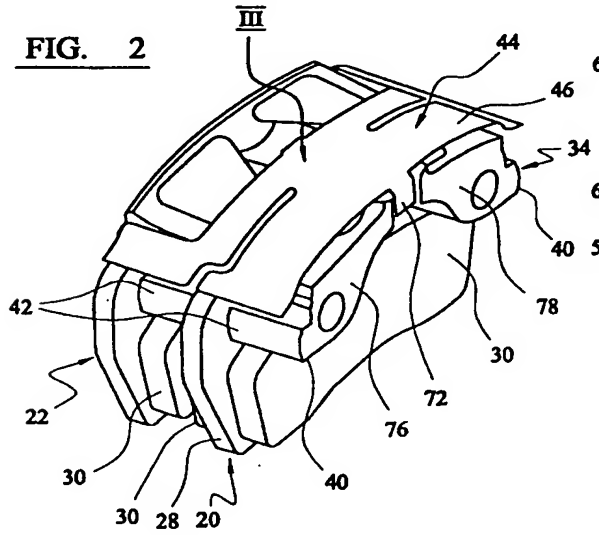
(56) Documents Cited
WO 98/25804 A DE 004332713 A US 5251727 A

(58) Field of Search
UK CL (Edition R) F2E EEL EHB
INT CL[7] F16D 65/097
ON-LINE: EPODOC, JAPIO, WPI

(54) Abstract Title
Apparatus and method for mounting friction elements in disc brakes

(57) Method and apparatus for mounting friction elements 20, 22 in a spot-type sliding disc automotive disc brake employs a leaf spring 46 comprising a first portion 48 to bias the friction elements 20, 22 generally in a radially inward direction with respect to the brake disc, and a second portion 50 adapted to provide a mounting function in relation to the spring 46 by means of axially-directed forces (with respect to the disc), whether by means of a resilient clipping action, or by a clamping action between the spring second portion 50 and a portion of the fixed caliper or bridge 34 of the disc brake. In the embodiments, the spring second portion 50 is provided by downwardly extending spaced tags 72, 74 provided in a central region of the leaf spring 46.

FIG. 2



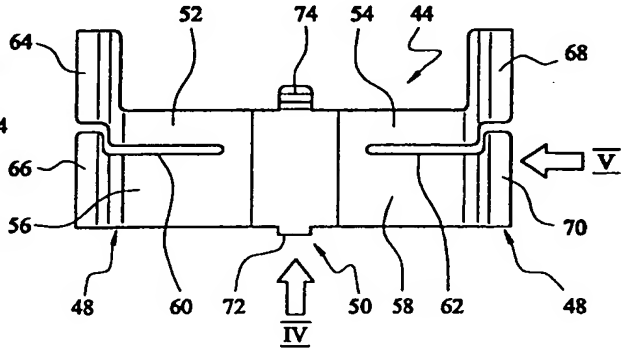


FIG. 3

GB 2 361 970 A

APPARATUS AND METHOD FOR MOUNTING FRICTION ELEMENTS IN DISC BRAKES

This invention relates to a method and apparatus for mounting friction elements in disc brakes. A particular embodiment of the invention relates to the mounting of friction elements in a disc brake of the kind in which at least one brake disc is axially slidable with respect to its associated rotatable mounting and at least one of the friction elements which frictionally engage braking surfaces at opposite sides of the disc are slidably mounted on a fixed caliper or bridge structure which resists movement of the friction elements under the action of the frictional forces generated by engagement of same with the rotating brake disc during actuation of the brake. Certain aspects of the invention may find wider application than strictly in relation to a disc brake of the kind just described.

There is disclosed in our prior-published specification WO 98/26912 (docket 2558) and in WO 98/25804 (docket 2561) a disc brake of the kind described above in which resilient means is provided in relation to at least one axially slidable disc and in relation to at least one axially slidable friction element, the latter resilient means being provided as an anti-rattle spring for the pads. In the above-identified prior publications the arrangement adopted for mounting the resilient means (acting on the friction pads) in relation to the fixed caliper or bridge structure has been on the basis of using the fixed and stable structure of the caliper or bridge as a mounting for providing the basis or foundation from which the resilient means takes its mounting for exerting the necessary forces on the friction elements. Such an arrangement has been considered a logical basis for the construction of an

assembly in which there is a need for a high degree of structural and operational integrity achievable on the basis of, inter alia, simplicity of structure and assembly, and minimisation of mechanical wear in use, and related factors.

In the embodiments of the above-identified previously-published arrangements of friction-mounting in disc brakes, there has been adopted the use of a leaf-type spring acting from the caliper or bridge (as an anti-rattle spring), and mounted thereon by suitable means (such, for example as fasteners), and a suitable connection to the friction elements accordingly.

We have identified a need for improvements in relation to the construction and functions of the resilient means provided for friction element mounting (and resilient loading) in disc brakes of the kind concerned. While the required resilient effect can be achieved by means of our above-mentioned previously-considered arrangement utilising a leaf spring, we have determined by means of further investigations that improvements are desirable at least in relation to the manufacturing cost and assembly cost implications of the previously-considered method of mounting the resilient means in relation to the fixed caliper or bridge, not to mention the fact that the adoption of such a spring arrangement and its mounting screws has space-taking implications for the disc brake assembly.

Therefore, we have identified a significant need for an improvement in relation to the springing and mounting functions of the resilient means provided as part of the mounting system for the friction elements in a disc brake of the kind concerned, and an object of the present

invention is to provide improvements in relation to one or more of the factors discussed above, or indeed improvements generally.

According to the invention there is provided a method and corresponding apparatus as set forth in the accompanying claims.

In the embodiments described below, the resilient means comprises leaf spring means comprising first and second portions adapted to provide respective distinct functions in relation to forces acting respectively generally in a radial direction with respect to the brake disc and generally axially with respect to the brake disc.

Thus, the first portion of the leaf spring means comprises leaf spring arms adapted to exert a resilient effect with a generally radially inward direction (with respect to the brake disc) on opposite sides of at least one of the friction elements of the brake. This function provides the required spring effect in relation to the friction elements for purposes of dynamic control.

In addition to the function provided by the first portion of the resilient means, there is provided, in the embodiments, the resilient means second portion, which has a distinct technical function in relation to forces acting in the dimensionally distinct direction namely generally axially with respect to the brake disc. Thus, in the embodiments, the second portion of the resilient means is generally in the form of a pair of spaced tags which are adapted to resiliently grip (or clip) or else to be gripped (or clamped) by means of forces acting generally in the said axial direction, so as to hold the resilient means in its required position with respect to the fixed caliper of

bridge structure.

Thus in one embodiment, the axial component of the effect exerted by the resilient means comprises a resilient gripping action, or a clamping effect, whereby the spring itself is effectively clipped or clamped into position by resilient (or otherwise) engagement with corresponding complementary formations on the fixed caliper or bridge.

The embodiments provide in a simple and cost-effective structure, the means whereby the required resilient effect of the spring in relation to the friction elements is combined with a mounting arrangement permitting the simple and direct mounting of the spring in relation to the fixed caliper or bridge without a requirement for the multiple operations both in terms of manufacturing and assembly which are inherent in alternative systems of mounting (involving for example the use of cap screws) requiring the provision of drilled and tapped bores.

In the embodiments, the combination of the radial and axial functions in a single spring enables (in those embodiments in which the spring is clipped in place), an extremely simple one-step assembly procedure which simultaneously resiliently deflects the spring (setting up the spring force on the friction element concerned) and at the same time effectively mounts the spring in its required position on the caliper or bridge. Even in the embodiments where the axial effect involves the use of a clamping effect produced by the structure of the caliper itself (for example by means of the caliper end plate) the simplicity of mounting is not significantly reduced because although the accommodation of the mounting tag preferably involves the provision of relieved portions in the caliper structure, such involves merely a minor profile modification not

significantly affecting manufacturing cost or complexity.

In the embodiments, it is envisaged that at least some of the advantages achievable by the illustrated embodiments may be achieved by the non-illustrated modification in which the first and second portions of the resilient means do not form an integral structure. Accordingly the first and second portions may be separate and merely cooperate in terms of the separatable second portion being adapted to retain the first portion in its working position on the fixed bridge or caliper.

It needs also to be noted that the resilient means adopted in the embodiments of the present invention have a resilient effect and generate a corresponding spring force which is of a magnitude such that it is significantly greater than that which is required merely for elimination of rattle, and a distinction is therefore to be drawn between the resilient means of the embodiments of the present invention and previously proposed anti-rattle springs in brakes of various kinds. The spring forces generated in the embodiments of the present invention are at a level such that the friction elements are constrained (by the predetermined spring forces) from sliding on their guides, whereby not only is rattling or noise suppression achieved but also the friction elements are restrained from free sliding movement into contact with the brake discs in an uncontrolled manner.

Embodiments of the invention will now be described by way of example with reference to the accompanying drawings in which:

Figure 1 shows in block diagram format a spot-type automotive disc brake comprising a pair of axially slidable discs and associated friction

elements, an actuating mechanism therefor and a fixed caliper or bridge structure overlying same;

Figures 2 to 5 show views of a first embodiment of the invention which is applicable to a disc brake of the kind shown in Fig 1, Fig 2 being a perspective view of the caliper assembly which in use includes a fixed friction element and a slidable friction element (the fixed element being omitted from the figure for clarity), and Figs 3, 4 and 5 being views of the resilient means or spring which is seen in Fig 2 and forms part of the caliper assembly, as seen generally in the directions indicated in Figs 2 and 3 by arrow III and in Fig 3 by arrows IV and V respectively; and

Figures 6 to 9 show a second embodiment of the invention which is likewise applicable to a disc brake of the kind shown in Fig 1, Fig 6 being a plan view of the resilient means and corresponding closely with Fig 3, Fig 7 being an elevation view of the resilient means corresponding to Fig 4 and showing the resilient means as viewed on arrows VII in Fig 6, and Fig 8 being a cross-sectional view on the line of VIII:VIII in Fig 6, and Fig 9 being a plan view of a blank in respect of the resilient means of Figs 6 to 8.

As shown in Fig 1 a spot-type automotive disc brake 10 comprises a pair of rotatable brake discs 12, 14, a rotatable mounting 16 for the brake discs to permit rotation of the discs and which is adapted to drive the

brake discs and have exerted thereon the braking effect by the discs when the disc brake 10 is actuated.

Two pairs of friction elements 18, 20 and 22 are provided and are adapted to frictionally engage braking surfaces 24, 26 provided at opposite sides of brake discs 12, 14 to effect braking on actuating actuation means for the brake. Central friction element 20 is double-sided for frictional engagement with the mutually-inwardly facing braking surfaces 24, 26 of brake discs 12, 14 and is provided with appropriately facing friction pad material accordingly. Friction elements 18, 20, 22 comprise (as shown in Fig 2) in each case a generally flat metal backing plate 28 and secured thereto and standing proud thereof a body of friction material 30 of known construction for high durability frictional engagement with the relevant braking surface of the relevant brake disc. In the case of central friction element 20, the friction material is provided at both faces of the backing plate 28.

Brake discs 12, 14 are axially slidable in use with respect to their rotatable mounting 16 under the action of friction elements 18, 20, 22 and the actuation means (to be described below) therefor during braking. For example the brake discs may be keyed to the rotatable mounting or hub 16 at three or more locations and resilient means may act there between.

A fixed mounting 32 for friction elements 18, 20,22 is provided comprising a caliper or bridge structure 34 which is mounted on a fixed structure of the vehicle to be braked, for example on the wheel mounting and which straddles the brake discs 12, 14 and also provides a mounting for actuation means 36,38 (indicated diagrammatically) which applies inwardly directed braking

forces to the outer friction elements 18, 22, thereby causing frictional engagement with the brake discs 12, 14 and slight sliding movement of those discs with respect to their rotatable mounting 16. In Fig 1 of course it can be seen that the clearances between the structures have been greatly exaggerated for simplicity of diagrammatic illustration. The actuation means 36, 38 could comprise a pair of piston and cylinder assemblies. However only one such is strictly needed since the actuation means can be one-sided with a fixed structure at one side or the other of the assembly of discs and friction elements (which fixed structure could simply be a stop extending from caliper 34), and against which fixed structure the assembly is pushed by the single actuation means.

Fixed mounting 32 for the friction elements 18 to 22 is adapted permit sliding movement of the friction elements into and out of frictional engagement with the brake discs while resisting movement of the friction elements under the action of frictional forces generated by engagement of the friction elements with the discs 12, 14. As shown in Fig 2, two of the friction elements 20, 22 are slidably mounted on the caliper 34 by means of a pair of axially extending guide rails 40 provided one at each side of the caliper 34, and complementarily-shaped grooves 42 formed in the friction element backing plates 28 whereby these latter are freely slidingly moveable on the rails 40, with a minimum of clearance or backlash, having regard to acceptable manufacturing tolerances. The other friction element 18 in this embodiment is fixed to caliper 34, the brake being actuated accordingly from one side.

Resilient means 44 is provided in relation to the fixed mounting 32 for the friction elements 18 to 22 and is adapted to act between the friction elements (at the

opposite sides of the brake discs) and caliper 34 in order to minimise friction element movement and/or noise and/or rattle with respect to the caliper or bridge 34 (and generally in a direction laterally with respect to the direction of inward movement of the friction element to engage the brake discs on commencing braking), as will be more fully described below.

Turning now to the construction of resilient means indicated generally by reference 44 as shown in Figs 2 to 5, it will be seen that the resilient means comprises leaf spring means 46, comprising first 48 and second 50 portions adapted to provide respective functions in relation to forces acting respectively in a generally radial direction and in a general axial direction with respect to brake discs 12, 14.

It needs to be explained that in Fig 2, the caliper assembly or structure 34 has been shown comprising only the two slidable friction elements, 22 and 20. The third friction element 18 is not shown, being a friction element which is fixed to caliper 34 and provides a stop against which the slidable assembly of friction elements 22 and 20 plus slidable discs 12, 14 are thrust during brake application. The fixed friction element 18, thus is simply mounted on a backing plate (not shown) fixed to caliper 34 and does not slide thereon. Thus, in this embodiment, the actuation means 36 in Fig 1 is not required.

It will now be appreciated that the first portion 48 of leaf spring means 46 exerts its resilient function in relation to the friction elements 20, 22 by exerting a spring force thereon acting in a direction generally radially inwardly with respect to the brake discs 12, 14. Fig 4 shows the profile of spring 46 in relation to such

deflection and it will be appreciated that the leaf spring elements 52, 54, 56, 58 which are separated by profiled slots 60, 62 exert their resilient effect on the friction elements independently through axially-extending end elements 64, 66 and 68, 70. It will be noted that leaf spring elements 56, 58 have a greater transverse dimension than the leaf spring elements 52, 54, whereby the former have a greater stiffness and spring effect, as is desirable in relation to the double-sided central friction element 20.

Turning now to the leaf spring second portion 50, this is located generally centrally of the overall spring structure and is formed integrally with first portion 48 and comprises a pair of downwardly (in the attitude of Fig 2) extending resilient tags 72, 74 which are generally of rectangular format and having the profiles indicated in Fig 8 such that, as shown in Fig 2, the tag 72 can co-operate with the fixed end plate (not shown) of the caliper or bridge 34 (which is secured by fasteners (not shown) to end faces 76, 78 on the caliper so that forces acting in the generally axial direction applied by the end plate hold the tag 72 in its working position (as shown in Fig 2) with respect to the caliper.

In an alternative embodiment (not illustrated) the tags 72, 74 are arranged to co-operate with the caliper so as to hold the leaf spring 46 by a clipping action involving resilient deformation of the tags 72, 74.

In the embodiment of Figs 6 to 9, there is shown a spring construction having a slightly modified profile as seen in plan view (Fig 6) and elevation view (Fig 7) as compared with Figs 3 and 4, but which is otherwise generally similar in function. Fig 9 shows the metal blank for the spring

corresponding to spring 46 in Figs 2 to 5.

No further description of the embodiment of Figs 6 to 9 is deemed necessary. Parts corresponding to those of Figs 2 to 5 are identified by related reference numerals increased by 100, whereby spring 46 becomes spring 146 etc.

Although in the description the invention has been described in relation to leaf type springs it will be appreciated that it could be applied to wire springs. There may however be certain disadvantages in terms of manufacturing economy in using such wire springs and leaf type springs are preferred.

It will also be appreciated that although the spring is described as acting radially inwardly relative to the disc, the arrangement in other embodiments could be configured with the spring acting radially outwardly.

CLAIMS

1. A method of mounting a friction element in a spot-type automotive disc brake, the disc brake comprising:-

a) at least one rotatable brake disc;

b) a rotatable mounting for said brake disc to permit such rotation and which is adapted to drive said brake disc and to have exerted thereon a braking effect by said brake disc when the disc brake is actuated;

c)at least one pair of friction elements adapted to frictionally engage braking surfaces on opposite sides of said brake disc to effect braking on actuation of actuation means therefor;

d) said brake disc being axially slidable in use with respect to said mounting therefor under the action of said friction elements and said actuation means therefor during braking;

e) a non-rotatable mounting for said friction elements adapted to permit sliding movement of at least one of same into and out of frictional engagement with said disc while resisting movement of both under the action of frictional forces generated by engagement of said friction elements with said disc;

f) resilient means being provided in relation to said non-rotatable mounting and adapted to act between said at least one friction element at one side of said disc and said fixed mounting therefor;

characterised by said method comprising:

g) the step of providing said resilient means comprising leaf spring means comprising first and second portions adapted to provide respective functions in relation to forces acting respectively in a generally radial direction and in a general axial direction with respect to said brake disc, the method comprising the step

of causing said first spring portion to exert its said respective function in relation to said at least one friction element of said pair of friction elements by exerting a spring force thereon acting in a direction at least generally radially inwardly with respect to said brake disc, and said method further comprising the step of causing said second spring portion to exert its said respective function in relation to said fixed mounting for said friction elements by mutual cooperation with said fixed mounting whereby said forces acting in a generally axial direction hold said resilient means in its working position with respect to said fixed mounting.

2. A method of mounting a friction element in a disc brake, the disc brake comprising at least one rotatable and axially slidable brake disc and at least one pair of friction elements therefor and a fixed mounting for said friction elements adapted to permit at least one friction element to effect sliding movement with respect thereto, and resilient means acting between said fixed mounting and said slidable friction element characterised by said resilient means comprising leaf spring means having first and second portions adapted to provide respective functions in relation to radial and axial (with respect to said brake disc) forces, the method comprising the step of causing said spring to provide said functions.

3. A method according to claim 1 or claim 2 characterised by the step of causing said resilient means to be clipped to said fixed mounting by resilient deformation of said second spring portion.

4. A method according to claim 1 or claim 2 characterised by the step of causing said resilient means to be clamped to said fixed mounting by engagement with

complementary formations on said fixed mounting.

5. A spot-type automotive disc brake, the disc brake comprising:-

a) at least one rotatable brake disc;

b) a rotatable mounting for said brake disc to permit such rotation and which is adapted to drive said brake disc and to have exerted thereon a braking effect by said brake disc when the disc brake is actuated;

c) at least one pair of friction elements adapted to frictionally engage braking surfaces on opposite sides of said brake disc to effect braking on actuation of actuation means therefor;

d) said brake disc being axially slidable in use with respect to said mounting therefor under the action of said friction elements and said actuation means therefor during braking;

e) a non-rotatable mounting for said friction elements adapted to permit sliding movement of at least one of same into and out of frictional engagement with said disc while resisting movement of both under the action of frictional forces generated by engagement of said friction elements with said disc;

f) resilient means being provided in relation to said non-rotatable mounting and adapted to act between said at least one friction element at one side of said disc and said fixed mounting therefor;

characterised by:

g) said resilient means comprising spring means comprising first and second portions adapted to provide respective functions in relation to forces acting respectively in a generally radial direction and in a general axial direction with respect to said brake disc, said first spring portion being adapted to exert its said respective function in relation to said at least one

friction element of said pair of friction elements by exerting a spring force thereon acting in a direction at least generally radially inwardly with respect to said brake disc, and said second spring portion being adapted to exert its said respective function in relation to said fixed mounting for said friction elements by mutual cooperation with said fixed mounting whereby said forces acting in a generally axial direction hold said resilient means in its working position with respect to said fixed mounting.

6. A disc brake comprising at least one rotatable and axially slidable brake disc and at least one pair of friction elements therefor and a fixed mounting for said friction elements adapted to permit at least one friction element to effect sliding movement with respect thereto, and resilient means acting between said fixed mounting and said slidable friction element characterised by said resilient means comprising spring means having first and second portions adapted to provide respective functions in relation to radial and axial (with respect to said brake disc) forces.

7. A disc brake according to claim 5 or claim 6 in which the spring means comprises leaf spring means.

8. A brake according to claim 5 or claim 6 or claim 7 characterised said resilient means being adapted to be clipped to said fixed mounting by resilient deformation of said second spring portion.

9. A disc brake according to claim 5 or claim 6 characterised by said resilient means being adapted to be clamped to said fixed mounting by engagement with complementary formations on said fixed mounting.

10. A disc brake according to any one of claims 5 to 9 characterised by said second portion of said resilient means being formed integrally with said first portion.

11. A disc brake according to any one of claims 5 to 9 characterised by said second portion of said resilient means being formed as a separate element adapted to hold said first portion in its working position.

12. A disc brake according to any one of claims 5 to 9 characterised by said first portion comprising a leaf spring having opposite end portions and said second portion of said resilient means being locate intermediate said end portions of said leaf spring.

13. A disc brake according to claim 12 characterised by said second portion of said resilient means comprising a pair of tags extending out of the plane of said leaf spring.

14. A method of mounting a friction element in a spot-type automotive disc brake substantially as described herein with reference to the accompanying drawings.

15. A disc brake substantially as described herein with reference to the accompanying drawings.

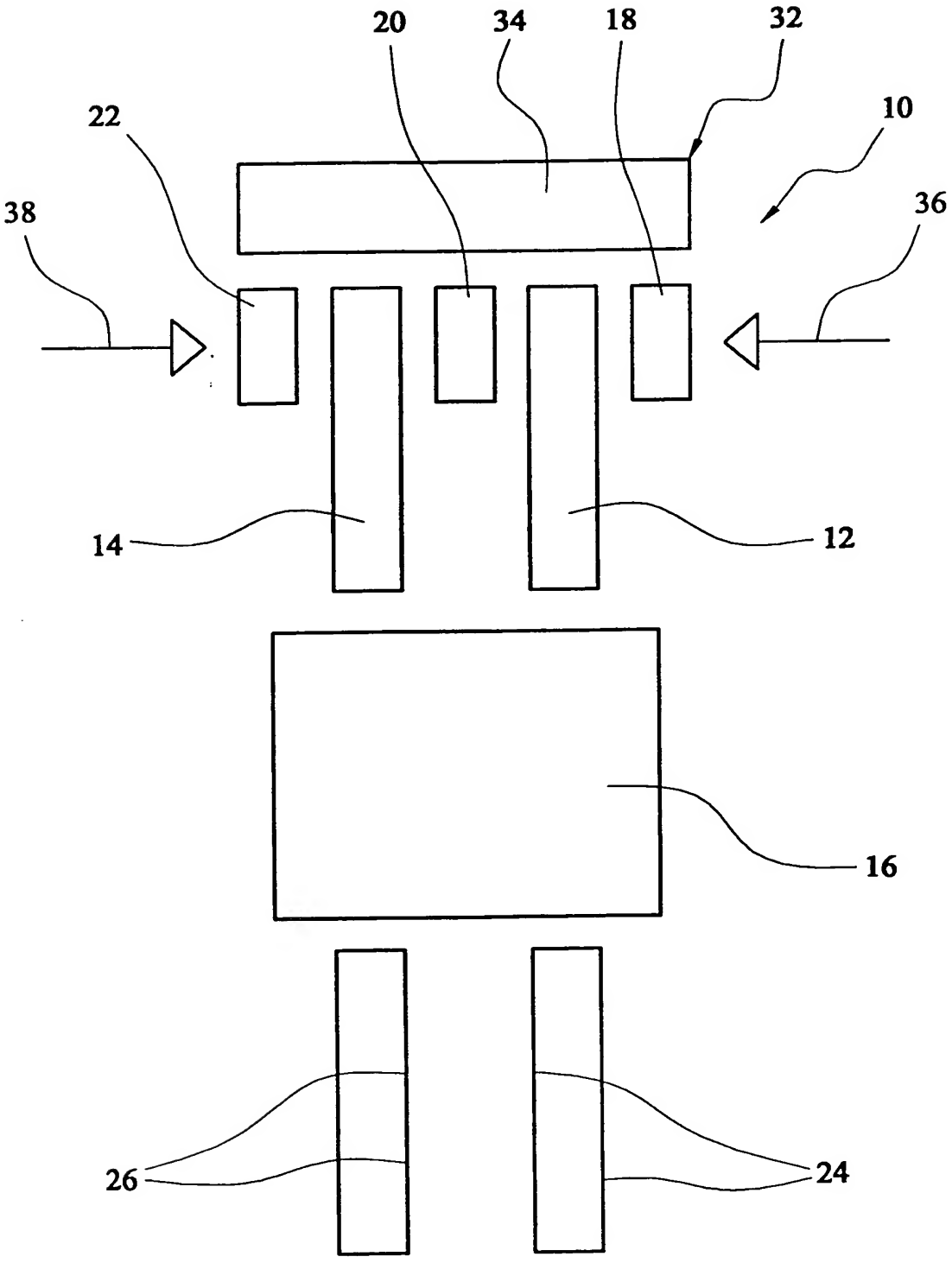
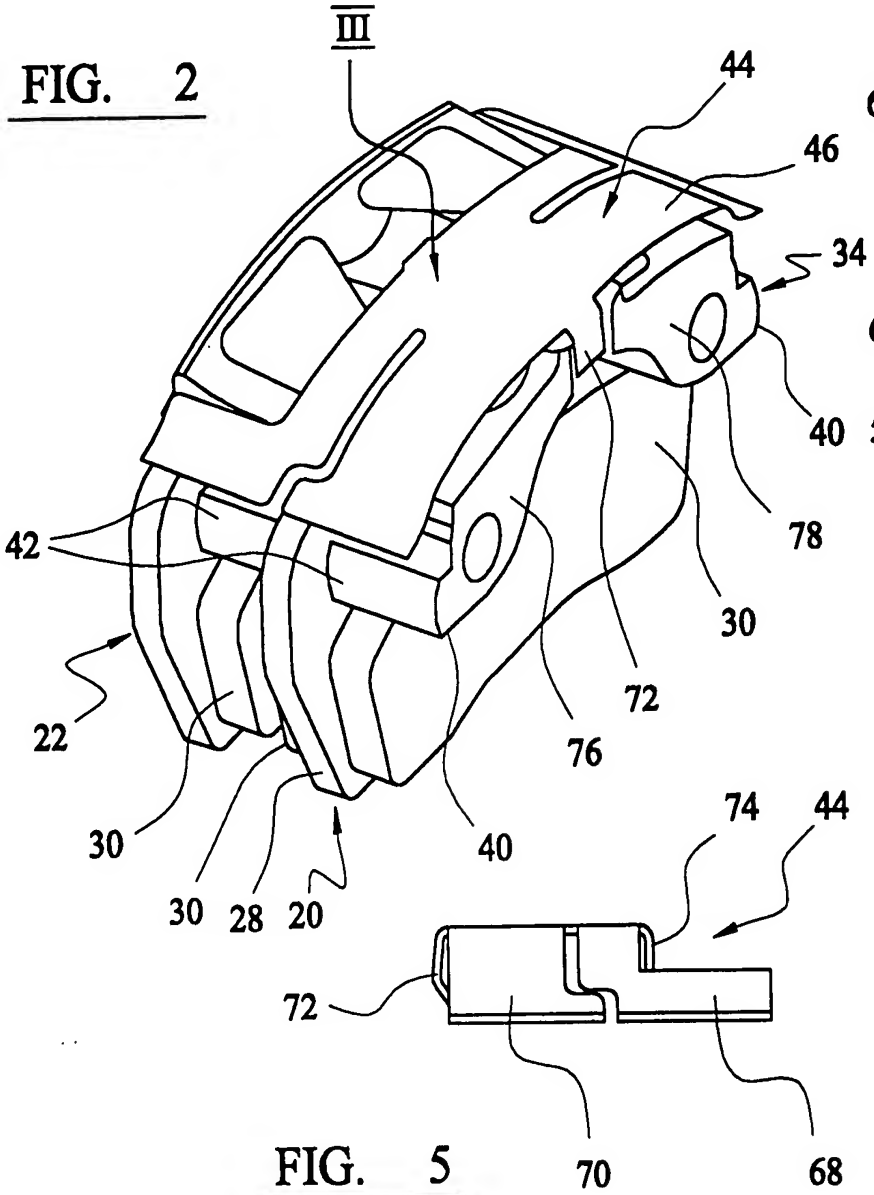


FIG. 1

FIG. 2



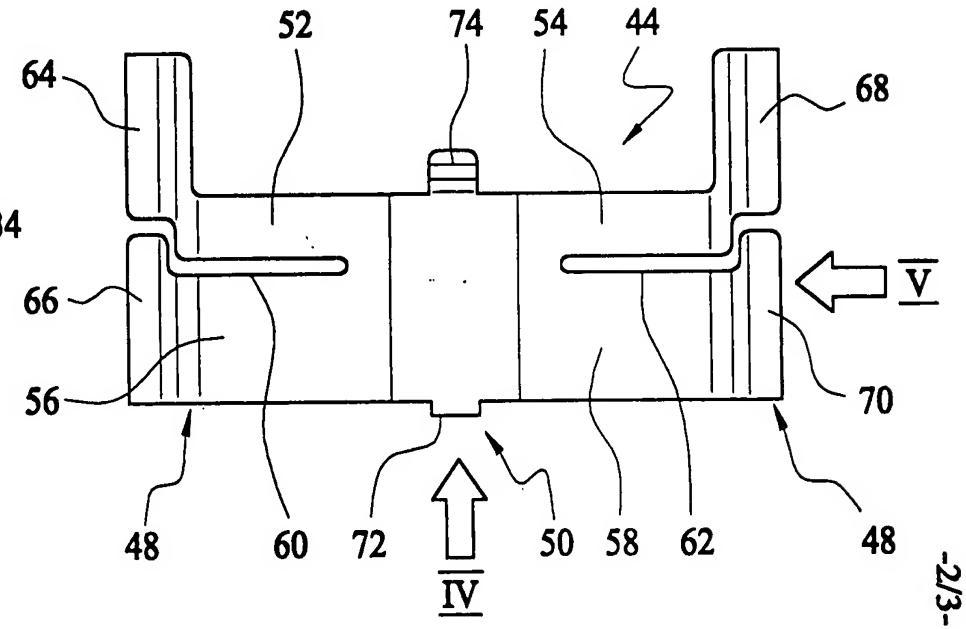


FIG. 3

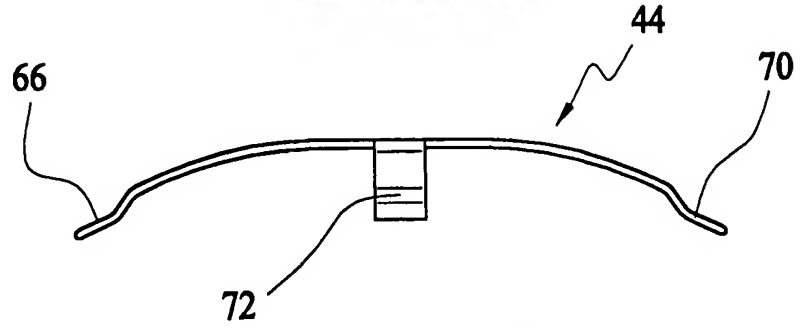


FIG. 4

FIG. 5

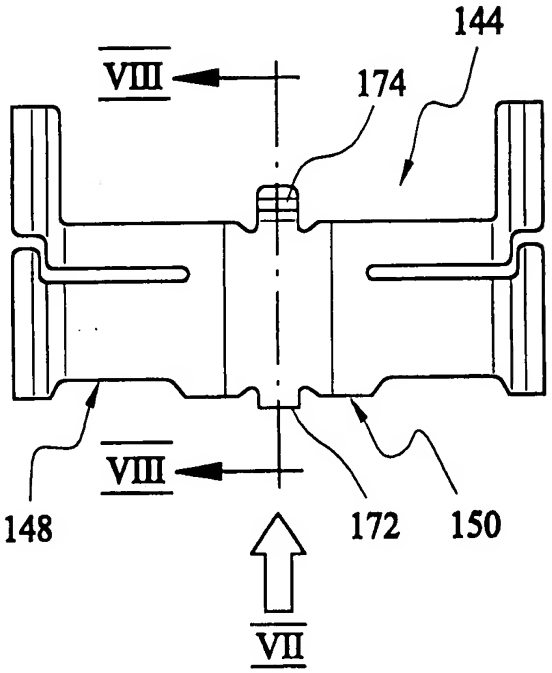


FIG. 6

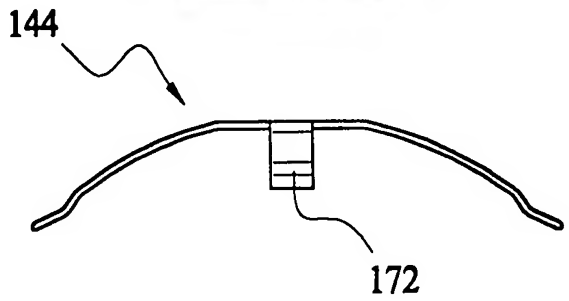


FIG. 7

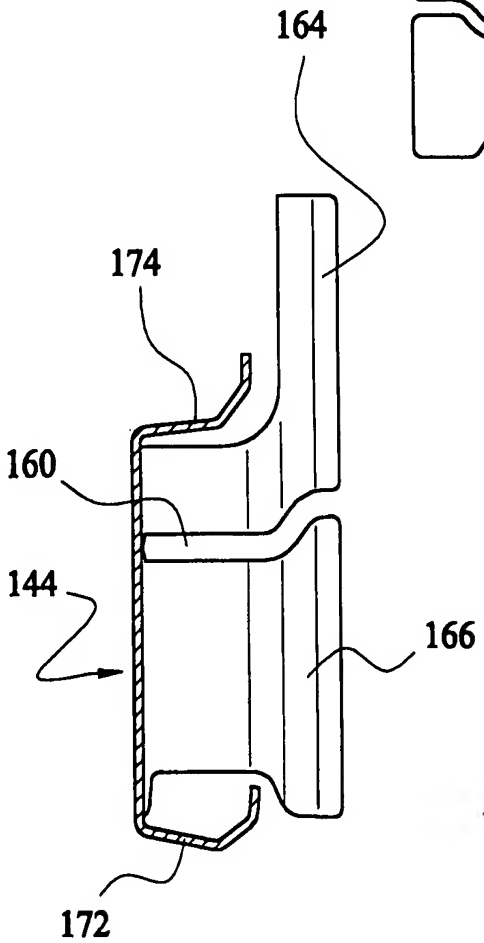


FIG. 8

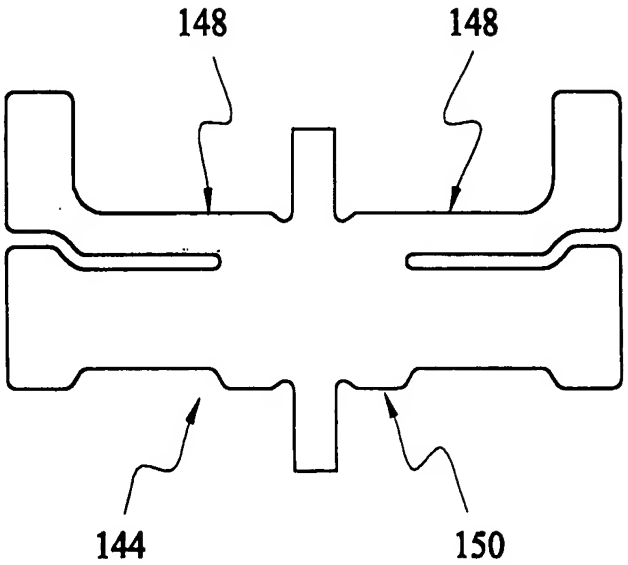


FIG. 9

The Patent Office
17
INVESTOR IN PEOPLE

Application No: GB 0010805.0
Claims searched: 1-15

Examiner: David McWilliams
Date of search: 19 September 2000

Patents Act 1977
Search Report under Section 17

Databases searched:

UK Patent Office collections, including GB, EP, WO & US patent specifications, in:

UK Cl (Ed.R): F2E (EEL, EHB)

Int Cl (Ed.7): F16D 65/097

Other: ON-LINE: EPODOC, JAPIO, WPI

Documents considered to be relevant:

Category	Identity of document and relevant passage		Relevant to claims
X,Y	WO 98/25804 A1	T&N (see spring 70, figure 1, page 7 lines 32-34)	X:1-10, 12,13 Y:1-10, 12,13
X	DE 4332713 A	TEVES (see spring 11 and WPI Abstract Accession No.1995-131908[18])	X:1-6,8-10 Y:7,12,13
Y	US 5251727	TEVES (see central axial finger/tab 18, figure 2)	1-10,12,13

X	Document indicating lack of novelty or inventive step	A	Document indicating technological background and/or state of the art.
Y	Document indicating lack of inventive step if combined with one or more other documents of same category.	P	Document published on or after the declared priority date but before the filing date of this invention.
&	Member of the same patent family	E	Patent document published on or after, but with priority date earlier than, the filing date of this application.